VERIFICATION OF A TRANSLATION

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declare as follows:

1. That I am well acquainted with both the English and Japanese languages

2. That the attached document is a true and correct translation made by me to the best of my knowledge and belief of:-

The specification accompanying the Application No. 2003-282696

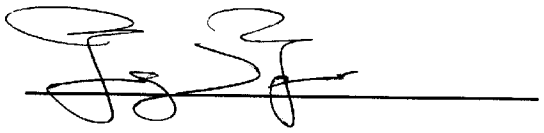
for a patent made in Japan

filed on July 30, 2003

Date

Signature of the translator

October 27, 2008



2003-282696

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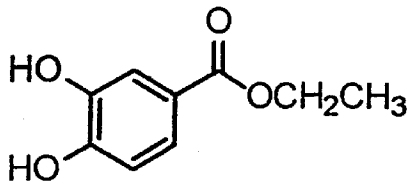
Representative	Kazumasa Tsunemi

[CLAIMS FOR PATENT]

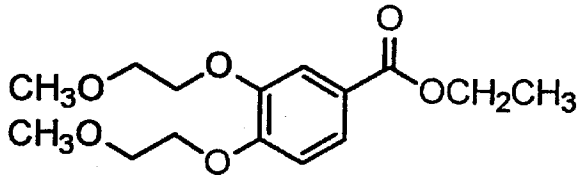
[Claim 1] A process for preparing 6,7-bis(2-methoxyethoxy)-quinazolin-4-one, which comprises

a first step of causing a reaction of ethyl 3,4-dihydroxybenzoate having formula (1):



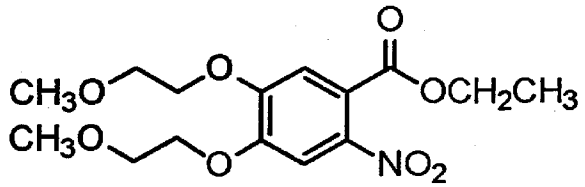
(1)

with 2-chloroethyl methyl ether in an organic solvent in the presence of a base to prepare ethyl 3,4-bis(2-methoxyethoxy)-benzoate having formula (2):



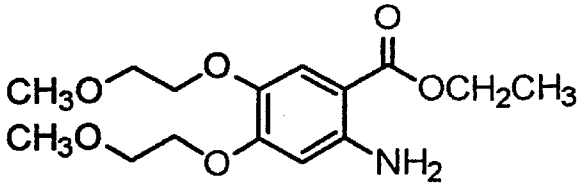
(2)

a second step of causing a reaction of the ethyl 3,4-bis-(2-methoxyethoxy)benzoate with nitric acid in the presence of sulfuric acid to prepare ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate having formula (3):



(3)

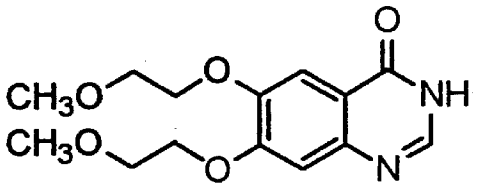
a third step of causing a reaction of the ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate with hydrogen in the presence of a metallic catalyst to prepare ethyl 2-amino-4,5-bis(2-methoxyethoxy)benzoate having formula (4):



(4)

and

a fourth step of causing a reaction of the ethyl 2-amino-4,5-bis(2-methoxyethoxy)benzoate with a formic acid compound in the presence of an ammonium carboxylate to prepare 6,7-bis(2-methoxyethoxy)quinazolin-4-one having formula (5):



(5)

[Claim 2] The process of claim 1 in which the reaction in the second step is performed at a temperature of 45 to 75°C.

[Claim 3] The process of claim 1, in which the formic acid compound used in the fourth step is an orthoformic acid ester.

[Claim 4] The process of claim 1, in which the ammonium carboxylate used in the fourth step is ammonium acetate.

[Specification]

[Title of the invention] Process for preparing 6,7-bis(2-methoxyethoxy)quinazolin-4-one

[Field of the invention]

The present invention relates to a process for preparing 6,7-bis(2-methoxyethoxy)quinazolin-4-one from ethyl 3,4-dihydroxybenzoate. The 6,7-bis(2-methoxyethoxy)quinazolin-4-one is an important synthetic intermediate for preparing 6,7-bis(2-methoxyethoxy)-4-(3-ethynylphenyl)aminoquinazoline hydrochloride valuable as an antitumor agent. See U.S. Patent No. 5,747,498.

[Background of the invention]

Japanese Patent Provisional Publication No. 2002-293773 discloses a process for preparing 6,7-bis(2-methoxyethoxy)-quinazolin-4-one from ethyl 3,4-dihydroxybenzoate. The process comprises a reaction of ethyl 3,4-dihydroxybenzoate with methoxyethyl mesylate in the presence of tetrabutylammonium iodide to give ethyl 3,4-bis(2-methoxyethoxy)benzoate, which is then nitrated by the use of a mixture of sulfuric acid and nitric acid to give ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate, which is then hydrogenated in methanol in the presence of platinum/carbon catalyst using hydrogen to give ethyl 2-amino-4,5-bis(2-methoxyethoxy)benzoate free base, which is then reacted with formamide in the presence of ammonium formate to finally give 6,7-bis(2-methoxyethoxy)quinazolin-4-one (total yield 68% from the amount of ethyl 3,4-dihydroxybenzoate). This process, however, has problems in that expensive tetrabutylammonium iodide and methoxyethyl mesylate and teratogenic formamide are involved. It is also disadvantage that the total yield from ethyl 3,4-dihydroxybenzoate is low. Therefore, the above-mentioned process is not favorably employable in industry to prepare 6,7-bis(2-methoxyethoxy)quinazolin-4-one.

[Disclosure of the invention]

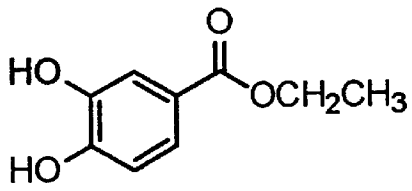
[Problems to be solved by the invention]

An object of the present invention is to solve the above-mentioned problems and to provide an easily employable industrial process for preparing 6,7-bis(2-methoxyethoxy)quinazolin-4-one from ethyl 3,4-dihydroxybenzoate in a high yield.

[Invention to solve the problems]

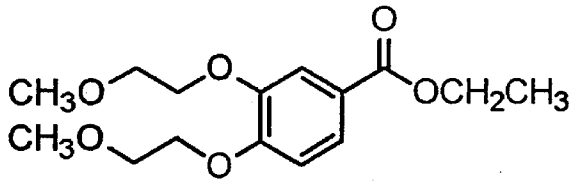
The problems can be solved by the process of the invention which comprises

a first step of causing a reaction of ethyl 3,4-dihydroxybenzoate having formula (1):



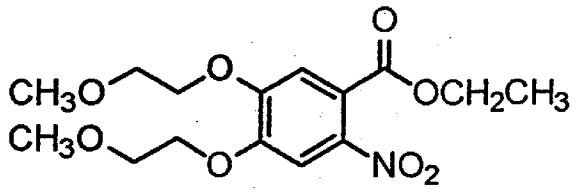
(1)

with 2-chloroethyl methyl ether in an organic solvent in the presence of a base to prepare ethyl 3,4-bis(2-methoxyethoxy)-benzoate having formula (2):



(2)

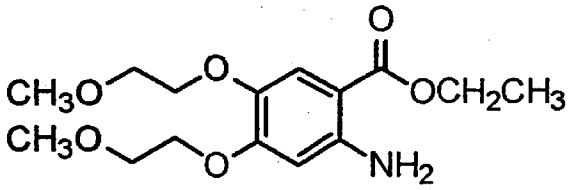
a second step of causing a reaction of the ethyl 3,4-bis-(2-methoxyethoxy)benzoate with nitric acid in the presence of sulfuric acid to prepare ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate having formula (3):



(3)

a third step of causing a reaction of the ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate with hydrogen in the presence of a metallic catalyst to prepare ethyl 2-amino-4,5-bis(2-methoxy-

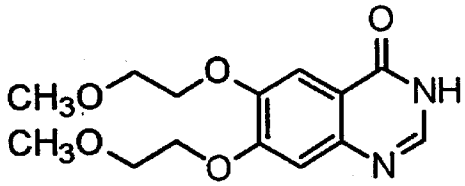
ethoxy)benzoate having formula (4):



(4)

and

a fourth step of causing a reaction of the ethyl 2-amino-4,5-bis(2-methoxyethoxy)benzoate with a formic acid compound in the presence of an ammonium carboxylate to prepare 6,7-bis(2-methoxyethoxy)quinazolin-4-one having formula (5):



(5)

[Effects of the invention]

The invention provides a process for preparing 6,7-bis(2-methoxyethoxy)quinazolin-4-one from ethyl 3,4-dihydroxybenzoate which gives the desired product in a high yield and which is easily and industrially employable in industry.

[Best mode for performing the invention]

(A) First step

In the first step, ethyl 3,4-dihydroxybenzoate reacts with 2-chloroethyl methyl ether in an organic solvent in the presence of a base to prepare ethyl 3,4-bis(2-methoxyethoxy)benzoate.

In the first step, the 2-chloroethyl methyl ether is used preferably in an amount of 1.0 to 20 moles, more preferably in an amount of 1.1 to 10 moles, and most preferably in an amount of 1.1 to 5.0 mole based on one mole of ethyl 3,4-dihydroxybenzoate.

Examples of the bases used in the first step include: alkali metal hydroxides such as sodium hydroxide, potassium hydroxide;

alkali metal carbonates such as sodium carbonate and potassium carbonate; alkali metal hydrogencarbonates such as sodium hydrogencarbonate and potassium hydrogencarbonate; and alkali metal alkoxides such as sodium methoxide and potassium methoxide. The alkali metal hydroxides and the alkali metal carbonates are preferred. The alkali metal carbonates are more preferred. Most preferred is potassium carbonate. The base can be used alone or in combination.

The base is preferably used in an amount of 1.0 to 20 moles, more preferably in an amount of 1.1 to 10 moles, and most preferably in an amount of 1.1 to 5.0 moles based on one mole of ethyl 3,4-dihydroxybenzoate.

There are no specific limitations with respect to the organic solvent used in the first step, unless the organic solvent disturbs the reaction. Examples of the organic solvents include: alcohols such as methanol, ethanol, isopropanol and t-butanol; ketones such as acetone, methyl ethyl ketone and methyl isobutyl ketone; amides such as N,N-dimethylformamide and N-methylpyrrolidone; ureas such as N,N'-dimethylimidazolidinone; sulfoxides such as dimethyl sulfoxide; nitriles such as acetonitrile and propionitrile; ethers such as diethyl ether, diisopropyl ether, tetrahydrofuran and dioxane; and aromatic hydrocarbons such as toluene and xylene. The ketones, nitriles and amides are preferred. The organic solvent can be used alone or in combination.

The amount of the organic solvent is adjusted in consideration of homogeneity of the reaction solution and stirring conditions. The organic solvent is used preferably in an amount of 1 to 100 g, and more preferably in an amount of 2 to 20 g based on 1 g of ethyl 3,4-dihydroxybenzoate.

The first step can be carried out, for example, by mixing ethyl 3,4-dihydroxybenzoate, 2-chloroethyl methyl ether, a base and an organic solvent under stirring in an inert gas atmosphere. The reaction temperature is preferably in the range of 20 to 200°C, and more preferably in the range of 40 to 120°C. There are no specific limitations with respect to the reaction pres-

sure.

In the first step, ethyl 3,4-bis(2-methoxyethoxy)benzoate is obtained. After the reaction is complete, ethyl 3,4-bis(2-methoxyethoxy)benzoate can be isolated or purified for the second step. The isolation or purification can be conducted according to the conventional method such as filtration, concentration, distillation, recrystallization, crystallization, or column chromatography. Ethyl 3,4-bis(2-methoxyethoxy)benzoate can also be used in the second step without conducting isolation or purification. In the case that isolation or purification is not conducted, the solvent can be replaced in the second step.

(B) Second step

In the second step, ethyl 3,4-bis(2-methoxyethoxy)benzoate reacts with nitric acid in the presence of sulfuric acid to prepare ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate.

In the second step, nitric acid is used preferably in an amount of 1.0 to 50 moles, more preferably in an amount of 2.0 to 10 moles based on one mole of ethyl 3,4-bis(2-methoxyethoxy)-benzoate. The nitric acid has a concentration preferably in the range of 40 to 90 wt.%, and more preferably in the range of 50 to 70 wt.%.

The second step is preferably carried out in the presence of a solvent. There are no specific limitations with respect to the solvent, unless the solvent participates in the reaction. Examples of the solvents include carboxylic acids such as formic acid, acetic acid, propionic acid and butyric acid. Acetic acid is preferred. The solvent can be used alone or in combination.

The amount of the solvent is adjusted in consideration of homogeneity of the reaction solution and stirring conditions. The solvent is used preferably in an amount of 1 to 50 g, and more preferably in an amount of 1.1 to 20 g based on 1 g of ethyl 3,4-bis(2-methoxyethoxy)benzoate.

The second step can be carried out, for example by mixing ethyl 3,4-bis(2-methoxyethoxy)benzoate, nitric acid, sulfuric acid and a solvent under stirring in an atmosphere of an inert

gas. The reaction temperature is preferably in the range of 20 to 90°C, more preferably in the range of 30 to 80°C, and most preferably in the range of 45 to 75°C. There are no specific limitations with respect to the reaction pressure.

In the second step, ethyl 4,5-bis(2-methoxyethoxy)-2- nitrobenzoate is obtained. After the reaction is complete, ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate can be isolated or purified for the third step. The isolation or purification can be conducted according to the conventional method such as filtration, concentration, distillation, recrystallization, crystallization, or column chromatography. Ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate can also be used in the third step without conducting isolation or purification. In the case that isolation or purification is not conducted, the solvent can be replaced in the third step.

(C) Third step

In the third step, ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate reacts with hydrogen in the presence of a metallic catalyst to prepare 2-amino-4,5-bis(2-methoxyethoxy)benzoate.

The metallic catalyst used in the third step can contain at least one metal atom selected from the group consisting of palladium, platinum and nickel. Examples of the metallic catalysts include palladium/carbon, palladium/barium sulfate, palladium hydroxide/carbon, platinum/carbon, platinum sulfide/carbon, palladium-platinum/carbon, platinum oxide and Raney nickel. Palladium/carbon, platinum/carbon, platinum sulfide/carbon and Raney nickel are preferred. The platinum/carbon catalyst is particularly preferred. The metallic catalyst can be used alone or in combination.

In the third step, the metallic catalyst is used preferably in an amount of 0.1 to 1,000 mg in terms of metal atom amount, and more preferably in an amount of 0.5 to 500 mg based on 1 g of ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate. When the metallic catalyst comprises a metal carried on a carrier, the amount of the metal on the carrier preferably is in the range of 1 to

2.9 wt.% based on amount of the carrier.

In the third step, hydrogen is used preferably in an amount of 3 to 50 moles, and more preferably in an amount of 3 to 10 moles based on one mole of ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate.

The reaction in the third step is preferably carried out in the presence of a solvent. There are no specific limitations with respect to the solvent, unless the solvent disturbs in the reaction. Examples of the solvents include: water; alcohols such as methanol, ethanol, isopropanol, n-butanol, and t-butanol; carboxylic esters such as methyl acetate, ethyl acetate, and methyl propionate; aromatic hydrocarbons such as benzene, toluene, xylene, and mesitylene; and ethers such as diethyl ether, tetrahydrofuran, and dioxane. The alcohols and carboxylic esters are preferred, and methanol and ethanol are more preferred. The solvent can be used alone or in combination.

The amount of the solvent is adjusted in consideration of homogeneity of the reaction solution and stirring conditions. The solvent is used preferably in an amount of 1 to 100 g, and more preferably in an amount of 2 to 30 g based on 1 g of ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate.

The reaction of the invention can be carried out, for example, by mixing ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate, a metallic catalyst and a solvent under stirring in the presence of hydrogen gas (which can be diluted with an inert gas). The reaction temperature is preferably in the range of 0 to 300°C, and more preferably in the range of 20 to 200°C. The reaction pressure is preferably in the range of 0.1 to 10 MPa, and more preferably in the range of 0.1 to 2 MPa.

After the reaction is complete, the final product, i.e., ethyl 2-amino-4,5-bis(methoxyethoxy)benzoate, can be isolated or purified for the fourth step. The isolation or purification can be conducted according to the conventional method such as filtration, concentration, distillation, recrystallization, crystallization, or column chromatography. Ethyl 2-amino-4,5-bis(methoxyethoxy)benzoate can also be used in the fourth step without

conducting isolation or purification. In the case that the isolation or purification is not conducted, the solvent can be replaced in the fourth step.

(D) Fourth step

In the fourth step, ethyl 2-amino-4,5-bis(2-methoxyethoxy)-benzoate reacts with a formic acid compound in the presence of an ammonium carboxylate to prepare 6,7-bis(2-methoxyethoxy)-quinazolin-4-one.

Examples of the formic acid compounds include: formic acid; formic esters (e.g., methyl formate and ethyl formate); and orthoformic esters (e.g., methyl orthoformate and ethyl orthoformate). Formic esters and orthoformic esters are preferred. More preferred are orthoformic esters. Most preferred are methyl orthoformate and ethyl orthoformate.

In the fourth step, the formic acid compound is used preferably in an amount of 1.0 to 30 moles, and more preferably in an amount of 1.1 to 10 moles based on one mole of ethyl 2-amino-4,5-bis(2-methoxyethoxy)benzoate.

In the fourth step, an ammonium carboxylate is used. Examples of the ammonium carboxylates include: ammonium aliphatic carboxylates (e.g., ammonium formate, ammonium acetate, and ammonium propionate); and ammonium aromatic carboxylates (e.g., ammonium benzoate and ammonium dichlorobenzoate). Ammonium aliphatic carboxylates are preferred. More preferred are ammonium formate and ammonium acetate. Most preferred is ammonium acetate. The ammonium carboxylate can be used alone or in combination.

In the fourth step, the ammonium carboxylate is used preferably in an amount of 1.0 to 30 moles, and more preferably in an amount of 1.1 to 10 moles based on one mole of 2-amino-4,5-bis(2-methoxyethoxy)benzoate.

The reaction in the fourth step can be carried out in the presence of a solvent. The reaction can also be carried out without a solvent. There are no specific limitations with respect to the solvent, unless the solvent participates in the

reaction. Examples of the solvents include alcohols such as methanol, ethanol, isopropanol, n-butanol, and t-butanol; amides such as N,N-dimethylformamide and N-methylpyrrolidone; ureas such as N,N'-dimethylimidazolidinone; sulfoxides such as dimethyl sulfoxide; aromatic hydrocarbons such as benzene, toluene, xylene, and mesitylene; halogenated hydrocarbons such as methylene chloride, chloroform, and dichloroethane; nitriles such as acetonitrile, and propionitrile; and ethers such as diethyl ether, tetrahydrofuran, and dioxane. The alcohols, amides and nitriles are preferred. More preferred are methanol, ethanol, N,N'-dimethylimidazolidinone and acetonitrile. The solvent can be used alone or in combination.

The amount of the solvent is adjusted in consideration of homogeneity of the reaction solution and stirring conditions. The solvent is used preferably in an amount of 0 to 50 g, more preferably in an amount of 0 to 20 g, and most preferably in an amount of 0 to 5 g based on 1 g of ethyl 2-amino-4,5-bis(2-methoxyethoxy)benzoate.

The reaction in the fourth step can be carried out, for example, by mixing an ammonium carboxylate, ethyl 2-amino-4,5-bis(2-methoxyethoxy)benzoate, a formic acid compound and a solvent under stirring in an inert gas atmosphere. The reaction temperature is preferably in the range of 40 to 200°C, and more preferably in the range of 50 to 150°C. There are no specific limitations with respect to the reaction pressure.

After the reaction is complete, the final product, i.e., 6,7-bis(2-methoxyethoxy)quinazolin-4-one, can be isolated or purified. The isolation or purification can be conducted according to the conventional method such as filtration, concentration, distillation, recrystallization, crystallization, or column chromatography.

The present invention is further described by referring to the following non-limiting examples.

[Example 1] (Synthesis of ethyl 3,4-bis(2-methoxyethoxy)benzoate)

In a 20 L-volume glass reaction vessel equipped with a

stirrer, a thermometer and a reflux condenser, 1,300 g (7.14 moles) of ethyl 3,4-dihydroxybenzoate, 2,324 g (21.4 moles) of 2-chloroethyl methyl ether, 2,958 g (21.4 moles) of potassium carbonate and 6,500 mL of N,N-dimethylformamide were placed. The mixture was allowed to react with each other at 90 to 100°C for 9 hours while stirring. After the reaction was complete, the reaction solution was cooled to room temperature. The reaction solution was then filtered, and washed with 6,500 mL of acetone. The filtrate was concentrated, 3,900 mL of ethyl acetate and 3,900 mL of a saturated aqueous sodium carbonate solution were added to the concentrate. The separated organic layer (ethyl acetate layer) was washed twice with 3,900 mL of a saturated aqueous sodium chloride solution to obtain a solution mixture containing ethyl 3,4-bis(2-methoxyethoxy)benzoate. The solution mixture was analyzed (according to an absolute quantitative method) by a high performance liquid chromatography. It was confirmed that 2,023 g of ethyl 3,4-bis(2-methoxyethoxy)benzoate was produced (reaction yield: 95%). After 3,939 mL of acetic acid was added to the solution mixture, the mixture was concentrated under reduced pressure to distill ethyl acetate off. Thus, an acetic acid solution of ethyl 3,4-bis(2-methoxyethoxy)-benzoate was obtained.

[Example 2] (Synthesis of ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate)

In a 20 L-volume glass reaction vessel equipped with a stirrer, a thermometer and a reflux condenser, the acetic acid solution containing 2,023 g (6.78 moles) of ethyl 3,4-bis(2-methoxyethoxy)benzoate prepared in the Example 1 was placed. To the solution, 318 g (3.18 moles) of concentrated sulfuric acid was gently added while stirring the solution at room temperature. The mixture was heated to 60 to 70°C. To the mixture, 1,857 g (20.34 moles) of 69 wt.% nitric acid was gently added while stirring the mixture. The resulting mixture was allowed to react for 2 hours while maintaining the temperature. After the reaction was complete, the reaction solution was cooled to room

temperature. To the reaction solution, 5,200 mL of a 20 wt.% aqueous sodium chloride solution and 5,200 mL of toluene were added. The separated organic layer (toluene layer) was washed twice with 7,800 mL of a 1 mole per L aqueous sodium hydroxide solution, and further washed twice with 7,800 mL of a 20 wt.% aqueous sodium chloride solution. The organic layer was concentrated under reduced pressure to obtain 2,328 g of ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate as an orange liquid (isolation yield: 100%).

[Example 3] (Synthesis of ethyl 2-amino-4,5-bis(2-methoxyethoxy)-benzoate)

In a 20 L-volume glass reaction vessel equipped with a stirrer, a thermometer and a reflux condenser, 2,328 g (6.78 moles) of the ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate prepared in the Example 2, 2 wt.% platinum per 118 g of carbon (50 wt.% product, N.E. Chemcat Corporation, 6.0 mmoles in terms of platinum metallic atom) and 9,440 mL of methanol were placed. The mixture was allowed to react at 50 to 60°C for 6 hours in an atmosphere of hydrogen while stirring. After the reaction was complete, the reaction solution was cooled to room temperature, and filtered. The filtrate was concentrated under reduced pressure to obtain 1,960 g of ethyl 2-amino-4,5-bis(2- methoxyethoxy)benzoate as an orange liquid (isolation yield: 92%).

[Example 4] (Synthesis of 6,7-bis(2-methoxyethoxy)quinazolin-4-one)

In a 20 L-volume glass reaction vessel equipped with a stirrer, a thermometer and a reflux condenser, 1,600 g (5.11 moles) of the ethyl 2-amino-4,5-bis(2-methoxyethoxy)benzoate prepared in the Example 3, 1,626 g (15.3 moles) of methyl orthoformate, 1,181 g (15.3 moles) of ammonium acetate and 4,800 mL of methanol were placed. The mixture was allowed to react under refluxing conditions (60 to 70?C) for 7 hours while stirring. After the reaction was complete, the reaction solution was cooled to 60°C. To the reaction solution, 4,800 mL of methanol

was added. The mixture was stirred for 30 minutes while maintaining the temperature, cooled to 0 to 5°C, and further stirred for 1 hour. The resulting mixture was filtered to obtain 1,373 g of 6,7-bis(2-methoxyethoxy)quinazolin-4-one as white crystals (isolation yield: 91%).

The total yield based on ethyl 3,4-dihydroxybenzoate was 80%.

[Industrial Utility]

The invention relates to a process for preparing 6,7-bis-(2-methoxyethoxy)quinazolin-4-one from ethyl 3,4-dihydroxy-benzoate. The 6,7-bis(2-methoxyethoxy)quinazolin-4-one is an important synthetic intermediate for preparing 6,7-bis(2-methoxyethoxy)-4-(3-ethynylphenyl)aminoquinazoline hydrochloride valuable as an antitumor agent.

ABSTRACT

[Problems] An object of the invention is to provide an easily employable industrial process for preparing 6,7-bis(2-methoxyethoxy)quinazolin-4-one from ethyl 3,4-dihyroxybenzoate in a high yield.

[Invention]

The problems can be solved by the process comprising

(A) a first step of causing a reaction of ethyl 3,4-dihydroxybenzoate with 2-chloroethyl methyl ether in an organic solvent in the presence of a base to prepare ethyl 3,4-bis(2-methoxyethoxy)benzoate;

(B) a second step of causing a reaction of the ethyl 3,4-bis(2-methoxyethoxy)benzoate with nitric acid in the presence of sulfuric acid to prepare ethyl 4,5-bis(2-methoxyethoxy)-2- nitrobenzoate;

(C) a third step of causing a reaction of the ethyl 4,5-bis(2-methoxyethoxy)-2-nitrobenzoate with hydrogen in the presence of a metallic catalyst to prepare ethyl 2-amino-4,5-bis-(2-methoxyethoxy)benzoate; and

(D) a fourth step of causing a reaction of the ethyl 2-amino-4,5-bis(2-methoxyethoxy)benzoate with a formic acid compound in the presence of an ammonium carboxylate to prepare 6,7-bis(2-methoxyethoxy)quinazolin-4-one.

[Selection of Drawings] None